Managing Varroa Mites in Honey Bee Colonies

The varroa mite (Varroa destructor) *is the most serious pest of honey bee colonies worldwide. This parasite was first detected in North Carolina in 1990, having been introduced to the U.S. just three years earlier. Virtually all feral (or "wild") honey bee colonies have been wiped out by these mites, and beekeepers continue to struggle with varroa infestations in their hives. In North Carolina alone, the number of managed beehives has dropped by an estimated 44 percent since the invasion of the mites. It is vital, therefore, to understand the varroa mite and the options available for its control.*

MITE BIOLOGY

The varroa mite is an external parasite that attacks both adult bees and the developing honey bee larvae. The adult mites have a flattened oval shape, are reddish-brown in color, and are about 0.06 inches wide, about the size of the head of a pin (Figure 1). The mated female mite enters the cell of a developing bee larva and lays as many as six eggs. The developing mites feed on the bee pupa and, depending on the number of mites, may kill it, cause it to be deformed, or have no visible effect. While the male mite dies in the cell, the adult daughter mites climb onto an adult worker bee and feed on its hemolymph (a fluid known as "bee blood"). The female mite can then repeat the cycle by entering cells of other developing larvae. Mites prefer drone larvae over worker larvae, but they will infest worker larvae and eventually kill the colony if preventive measures are not taken.

The mites can also harm the bees indirectly. In addition to the obvious effects of mites feeding on developing and adult bees, the mites can also serve as transmitters of several viruses that can kill bees. These secondary infections are facilitated when the mites compromise the bees' immune systems. They can cause a condition known as *parasitic mite syndrome* (PMS), which can kill colonies within months of infection.

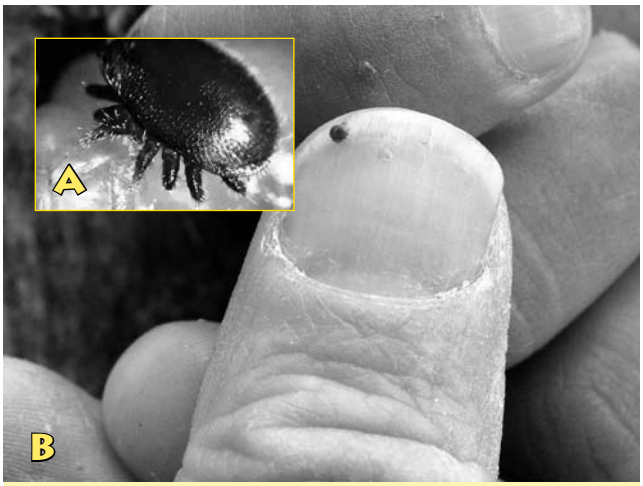

Figure 1. The varroa mite, *Varroa destructor*, the most insidious pest of honey bee colonies. *Photo A: courtesy of NCDA&CS. B: N.C. State Apicultural Program*

Figure 2. The sugar shake method for estimating mite levels. *N.C. State Apicultural Program*

DETECTION METHODS

Many bee colonies that succumb to varroa infestations will do so in the late summer or fall. It is difficult to simply inspect a colony and determine if it has a high level of mites. It is important, therefore, to sample beehives to estimate the degree of infestation.

Sugar shake method

This method estimates the mite *prevalence* within the colony (the percentage of adult bees with mites).

1. Obtain a clear 1-pint jar or other container with a lid made from 1/8-inch hardware cloth or similar mesh material. If you can't find a jar with a mesh lid, make a mesh lid for your container.
2. Brush or shake approximately 200 adult bees from a frame with an emerging brood into the jar.
3. Close the mesh lid on the jar, and add 2 to 3 tablespoons of 6× powdered sugar through the lid.
4. Set the jar aside for several minutes to allow the bees (and mites) to be covered in sugar.
5. Shake the sugar (and dislodged mites) out of the jar onto a clean, flat surface (preferably white). The bees, although covered in sugar, are not killed and can be returned to the colony.
6. If 10 or more mites are found per 200 bees, take appropriate measures to control the mite population (a magnifying glass may be necessary to see the mites).

Sticky board method

This method estimates the total mite *load* of the colony (the total number of mites in the hive).

1. Purchase a commercial sticky board from a beekeeping supply company. A sticky board has a pre-applied adhesive and sampling grid drawn on the surface. Alternatively, a sticky board can be constructed with a stiff sheet of white paper.
2. Spray the upper surface of the paper (facing the bees) with an aerosol cooking spray, or apply a thin layer of petroleum jelly to the upper surface of the paper to create a homemade sticky board.
3. Place the board or paper between two 8-mesh wire covers (with one cover on the top and one on the bottom) so that the bees do not adhere to the sticky surface.
4. Place the sticky board on the bottom floor of the hive. A portion of the mites will fall off the bees, fall through the mesh screen, and stick to the white board.
5. Remove the board 24 hours later, and count the total number of mites on it. If the number of mites is between 60 and 190 (depending on the size of the colony), then appropriate control measures should be taken.

Alcohol wash method

Similar to the sugar shake, this method requires that the beekeeper brush or shake adult bees from a frame into a clear container to measure the prevalence of varroa mites.

Figure 3. The sticky board method for estimating mite load. *N.C. State Apicultural Program*

1. Pour 1 to 2 inches of rubbing alcohol (isopropyl alcohol) into a clear 1-pint jar or container with a solid lid.
2. Brush or shake approximately 200 adult bees from a frame with emerging brood into the container.
3. Vigorously shake the container for at least 30 seconds, and then examine it for dead mites sinking to the bottom. If you see 10 or more mites per 200 bees, then you should treat the colony.

Drone brood inspection

Because of the variation in sampling, this method is not always a reliable indicator of mite levels in a colony. However, it can be used to verify the relative degree of varroa infestation.

1. Find any capped drone brood within the hive, which is typically located on the periphery of the brood nest.
2. Uncap the cells and gently remove the pupae.
3. Closely inspect the drone pupae for adult varroa mites. If 10 percent or more of the drones are infested, then you should take appropriate measures to reduce the mite population.

Current recommendations are to monitor each honey bee colony for varroa mite infestation several times over the course of a season to determine if and when treatment is necessary. Use different sampling techniques for your monitoring efforts to make sure that an accurate measure is obtained for each hive.

CONTROLLING VARROA MITES

Traditional methods for varroa mite control have been to hang plastic strips impregnated with chemical pesticides between the wax combs of beehives (see "Chemical treatments" below and Figure 5). Unfortunately, the mites are rapidly developing resistance to many of the common treatments, which has prompted researchers to develop alternative methods to prevent and treat varroa mite infestations. These methods range from structurally or mechanically modifying beehives, to obtaining new stocks that are more tolerant of mites, to using new biopesticides that are valuable alternatives to the standard synthetic treatments.

Mechanical control

Certain control methods involve changes in beekeeping management practices. The benefit of such mechanical control measures is that they do not use chemicals to reduce mite levels, thus they may be employed when the bees are collecting and producing honey. They may, however, be more laborious or require new equipment, and they may not be as effective as other control measures.

Screened bottom boards. Research has shown some benefit from replacing the wooden bottom of a standard beehive with a wire-mesh screen or other non-solid surface. Several studies have shown decreases in mite levels within colonies where hives have screened bottoms compared to solid bottoms. While the reasons for the decreased mite populations are unknown, the decrease may be due to better hive ventilation or to the loss of mites dropping through the floor of the hive. The benefits of bottom screens are minimal, however, and such hives usually require additional methods of treatment.

Drone-brood trapping. Varroa mites prefer to infest the drone brood in a hive, which consists of developing male honey bees. This is because drones are larger and take longer to develop, so female mites can produce more offspring per generation. Beekeepers may take advantage of this preference by placing special combs with drone-sized cells in their hives to attract mites to the brood. These combs can then be removed before the drones—and the mites—emerge from their cells. Depending on the time of year, this practice can dramatically reduce the mite populations within colonies.

Inert dusts. Adult mites move through the hive by clinging to the backs of adult bees. Some research has shown that covering all the adults in a colony with fine dust particles, such as powdered sugar or certain pollen substitutes, can cause the mites to lose their grip and fall off their hosts. This technique can be laborious and quite disruptive to a colony, but it requires no chemical pesticides.

Mite-tolerant stocks

Some of the more exciting advances in varroa mite control have been in honey bee genetics. In recent years, much work has been done to develop particular strains of honey bees that have shown tolerance to the varroa mite. Though the mechanisms are not completely understood, some behavioral and physiological traits probably play a role in varroa resistance. Today, several strains of bees are available that have been shown to reduce the number of varroa mites within their colonies.

Russian strain. Researchers at the USDA Honey Bee Research Lab in Baton Rouge, Louisiana, have imported bees from the Primorsky region in far-eastern Russia because they co-exist with the original host species of varroa, the sister honey-bee species *Apis cerana*. Because these Russian bees have been exposed to the varroa mite for a greater number of generations compared to other strains of bees, they may have developed a tolerance to the mite. Indeed, research has shown that they are more than twice as tolerant of varroa as other commercial bee stocks. Moreover, for reasons that are yet unclear, this stock appears to be highly resistant to the tracheal mite, a second parasitic mite that infests honey bee colonies. The Russian strain has been made available for commercial purchase in the U.S. after a protracted period in quarantine.

Hygienic behavior. Many queen breeders have actively bred for colony brood-nest *cleanliness* or hygienic behavior. Much research has demonstrated lower levels of numerous diseases in colonies selectively bred to uncap and removed diseased or parasitized brood (such as the Minnesota Hygienic stock). Although these stocks are not immune to varroa parasitism, they may significantly reduce the need for control methods.

VSH stock. Previously known as the SMR strain (for *suppression of mite reproduction*), this genetic trait was selected for by USDA researchers using classical bee breeding and instrumental insemination techniques. Bees of this stock exhibit high levels of hygienic behavior specifically towards varroa-parasitized pupae (hence *varroa-sensitive hygiene*, or VSH), causing the mites to have reduced rates of reproduction. This stock has been crossed with other, more common commercial stocks in an attempt to integrate this useful trait into other bee strains.

Biopesticides

Biopesticides are naturally occurring organisms or their by-products, and several have been registered for controlling varroa mites in honey bee colonies. The efficacy of many biopesticides can equal that of conventional chemical pesticides. The delivery of these chemicals, however, can be quite different, and understanding these differences is important to ensure successful control of varroa.

Apilife VAR. This product contains a combination of the essential oils thymol, eucalyptol, and menthol. It has been approved by the U.S. Environmental Protection Agency (EPA) for use in North Carolina to treat both varroa and tracheal mites. Several studies have shown that if used as instructed by the manufacturer, it destroys between 65 and 97 percent of the varroa mite population within a hive. The delivery medium of this product is a vermiculite tablet, which must be broken into four pieces and placed in the four corners of the hive between the brood chambers. Each piece must be wrapped in wire mesh to prevent the bees from chewing it and removing it from the hive prematurely. New tablets must be used every week for three weeks for complete effectiveness. The effectiveness of Apilife VAR depends on the temperature. This product can be used effectively only in temperatures above 60°F and below 90°F. It may cause significant mortality of bee brood, thus it may be most useful as a fall treatment when brood rearing naturally declines. Though Apilife VAR is considered an organic pesticide, it is a restricted-use chemical and can only be purchased and applied by individuals who have a valid N.C. Pesticide Applicators License.

Sucrocide. The biopesticide sucrose octanoate, derived from the tobacco plant, has recently been developed for varroa control under the trade name Sucrocide. It is delivered by spraying adult workers with the substance once every week for three weeks to kill mites as they emerge from brood cells. Some recent studies have shown that it is highly effective at killing mites when applied properly, but other studies sug-

Figure 4. Apilife VAR. *N.C. State Apicultural Program*

gest a more moderate level of control. This method requires significant time, labor, and hive manipulation, making it difficult to use in large-scale beekeeping operations. Nonetheless, it is a good alternative to other control methods that are either less effective or that utilize more stringent pesticides, particularly when dealing with only a few hives.

Formic acid. The EPA has recently permitted the use of formic acid for the control of varroa mites in the U.S. (under the trade name Mite-Away II). This method has been used by beekeepers in Canada and Europe for many years, and it is the only chemical pesticide that can be used for organic honey production. There are several delivery methods for formic acid, such as placing pads soaked with liquid formic acid on top of the hive. The product cannot be used during a honey flow, and the daily high temperatures must be between 50°F and 79°F. If temperatures exceed 82°F during the first week of treatment, it must be removed from the hive as it may result in significant losses of brood and adult bees. In small colonies (fewer than 6 to 20 frames), the bees can be overwhelmed by the fumes. Care must also be taken by the beekeeper while applying formic acid, as it is highly corrosive and poisonous to humans. The proper precautions must be taken to avoid exposure.

Chemical (synthetic pesticide) treatments

Conventional means of varroa control involve synthetic pesticides being administered to a colony by placing plastic strips impregnated with the active chemical within the hive. While these treatments have traditionally provided very high levels of control, the varroa mite is becoming increasingly resistant to these chemicals, which makes them less reliable in some areas.

Apistan. One of the first pesticides to be registered by the EPA for the control of varroa mites was Apistan, with the active ingredient fluvalinate, a synthetic pyrethroid. It is sold as a plastic strip impregnated with the pesticide, and the strips are hung between the frames of a hive just outside of the brood nest. Fluvalinate is a contact pesticide and provides up to 100 percent control of varroa mites when properly used. In recent years, however, there have been increasing reports of varroa mites developing resistance to this pesticide. It is highly recommended, therefore, that Apistan be rotated with other treatments to reduce the development of resistance to chemical control by the mites and to ensure its efficacy.

Checkmite+. The EPA registered another synthetic chemical as a Section 18 emergency-use pesticide for varroa control. Checkmite+, the trade name for coumaphos, is also sold as a plastic strip impregnated with the active pesticide. When the bees and mites come into contact with the pesticide, it can provide up to 100 percent control when used properly. Coumaphos is a member of the organophosphate group of pesticides, and residues can accumulate in wax and be harmful to bees at high levels. As with Apistan, there have been documented cases of varroa mites developing resistance to this pesticide, so it is important to use it according to label directions and to alternate its use with other approved treatments. Checkmite+ is also registered for the control of the small hive beetle (*Aethena tumida*), and its sale in North Carolina is restricted to those individuals who have a valid N.C. Pesticide Applicators License.

Figure 5. Administering chemical pesticides. *N.C. State Apicultural Program*

SUMMARY

1. Varroa mites are currently the greatest pest threat to honey bees and their colonies, and infested colonies will probably perish if action is not taken to control the mites. Thus, they are a significant threat to a beekeeper's income and satisfaction.
2. Monitoring hives for mite levels enables beekeepers to determine whether treatment is necessary and to make informed decisions about when to take action.
3. The exclusive and continual use of one chemical product is more likely to result in resistance by the pest. Several different products should be used on a rotating basis.
4. **Do NOT**, under any circumstances, **experiment with nonapproved chemical treatments. Such practices are *illegal*** and may result in bee death, the contamination of honey and wax, and severe harm to the beekeeper.
5. Because of the inherent risks with the use of chemical pesticides, and the fact that some of the available treatments can only be obtained by individuals with a current pesticide certification, it is recommended that all beekeepers receive training and certification through the N.C. Department of Agriculture and Consumer Services (NCDA&CS) Pesticide Licensing Program.
6. For additional information or assistance, contact your local NCDA&CS bee inspector, your local county Cooperative Extension center, or the Apicultural Program at North Carolina State University: **http://entomology.ncsu.edu/apiculture**

Table 1. Management practices for varroa mites in honey beehives.

Management Method	Chemical (if applicable)	Relative Effectiveness	Degree of Manipulation	Other Pests Controlled	License Required
Screened bottom board	—	Low	Low	—	—
Drone brood trapping	—	Moderate	Moderate	—	—
Inert dusts	—	Moderate	High	—	—
Mite-tolerant stocks	—	Moderate	Low	TM‡	—
Apilife VAR	Thymol	Moderate-High	Moderate	TM	Yes
Sucrocide	Sucrose octano-ate	Moderate-High	High	—	—
Mite-Away II	Formic acid	High	Moderate	TM	—
Apistan	Fluvalinate	High*	Low	—	—
CheckMite+	Coumaphos	High*	Low	SHB	Yes

** In areas where resistance has not developed; TM=Tracheal mite; SHB=Small hive beetle;*
‡ For Russian strain only

Acknowledgement

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N.C. State University, Department of Entomology and North Carolina Cooperative Extension.

For access to online Beekeeping Notes, visit the following Web site:
http://www.cals.ncsu.edu/entomology/apiculture/Beekeeping_notes.html

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Powder Sugar Roll for Varroa Sampling

Last Updated: August 26, 2009

To keep your honey bee colonies healthy, it is important to determine the level of varroa mites in your colonies. This method provides a good estimate of the number of varroa mites on the adult bees. This method has the advantage of not killing the bees.

More detail about the powder sugar roll method can be viewed in this downladable .pdf

- The methods described here are illustrated in the following University of Minnesota Instructional Poster "Powder Sugar Roll For Varroa Mites on Honey Bees" Download a .pdf here.

This is what the mites look like that you are trying to see.

If you know how many bees were in your sample, you can estimate the number of mites per 100 bees. If there is brood in the colony when you sample, you should double this number to factor in the amount of mites in worker brood. For example, if there are 5 mites / 100 bees, the total infestation is probably 10 mites/100 bees. If your colony has over 10-12 mites/100 bees, you should consider treatment.

Follow these 10 easy steps to determine the infestation level of varroa mites in a honey bee colony.

1. The first step is to make a container with a cover made of 8x8 hardware cloth. An easy method is to use a wide-mouth canning jar. Use a ring type cover. Cut a circle of 8x8 hardware cloth the size of the cover that fits in the ring and use it instead of the cover.

A wide-mouth canning jar with a cover made of 8x8 hardware cloth

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2. You will also need something white to shake the mites and powdered sugar into. You can just shake them onto a piece of paper if it is not windy. A white container works best but any light color (yellow) would be ok.

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3. Shake about 200-400 bees into the container. You can shake the bees from a frame into a bent piece of sheet metal (flashing) to help pour them into the container.

Remove a frame from the brood area to take a sample of bees for varroa mite sampling.

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4. 1 fluid oz. = approximately 100 bees. 1/4 cup = approximately 200 bees. You will have to shake the bees in, then tap the bottom of the container to get all the bees on the bottom of the container to measure them.

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5. With the bees in the container place the 8x8 screen on top and secure.

Put about 2 Tablespoons of powdered sugar into container.

6. Put about 2 Tablespoons of powdered sugar into container. Shake the bees with the powdered sugar until they are well coated. Let the container sit for about 1-2 minutes.

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7. Tip the container upside down over the white container and shake the powdered sugar and mites out through the screen.

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8. Continue to shake for at least one minute to be sure you have all of the mites.

The mites show up easier on a white background.

9. Count the number of mites in the powdered sugar. If you have trouble seeing them you can add a small amount of water to dissolve the sugar, making the mites easier to see.

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10. Return the bees to their colony.The bees will survive. Once they are cleaned up they can go back to work.

Source:
University of Minnesota Instructional Poster #155, Gary S. Reuter and Marla Spivak, Department of Entomology
Download the original Powder Sugar Roll for Varroa Sampling .pdf here.

This resource area was created by the: Bee Health community

Note 2.02
(Previously Note # 3A)

TRACHEAL MITES

INTRODUCTION

The tracheal mite (*Acarapis woodi*) was first detected in North Carolina in 1984 and initially it caused a great loss in managed and feral (wild) honey bee colonies. In recent years, the pest has become less of a problem as our bees have developed some resistance or at least tolerance to the mite pest However, beekeepers should still be aware of this pest which has periodically caused massive bee deaths in some areas of the state in recent years.

ECONOMIC IMPORTANCE

In North Carolina, severe losses have been encountered causing entire apiaries to die. Infested colonies are most likely to succumb during the stressful overwintering period, regardless of honey stores. Losses in recent years have been reduced but the mite can still be a problem. In addition to the economic losses incurred by beekeepers from reduced honey production and pollination fees, vegetable and fruit growers often rely on rented hives for crop pollination. A shortage of hives could adversely impact grower production or cause pollination rental fees to increase.

MITE BIOLOGY

The tracheal mite is a parasite of the adult honey bee and does not affect the immature stages of the bees except to the degree that the mite can kill most or all of the adult bees resulting in the loss of the entire colony. This parasite gets its name (tracheal mite) from the fact that it spends its entire life cycle (except for transferring to a new bee host) in the tracheal or breathing tubes of the honey bee.

This is an obligate pest of the honey bee and it can not live away from its host for more than a day or two and it does not appear to have any other hosts. The tracheal mite is a microscopic mite (even in the adult stage) and for all practical purposes it can not be readily seen with the naked eye.

Upon entering the tracheal tubes of the honey bee via the bee's spiracles, the adult female mite will begin to lay eggs in the tracheal tubes of its host. The female will spend the rest of its life cycle inside of the bee's tracheal tubes where the entire developmental cycle of the mite occurs (see Figure #1). The initial (mother) female mite will lay eggs that will produce both male and female mites that will feed on the body fluids of the host bee from the inside of the tracheal tubes. Under some conditions, mite numbers may grow to levels that result in the death of the infected bees and eventually the entire colony of bees.

The mites spread from bee to bee by the transfer of mated female mites to new bee hosts. The mated female will exit the tracheal system of an infested bee and then transfer "jump" onto a new bee host and enter that bee's tracheal system via the spiracles of the new host. Young bees, usually less than nine days old, are the preferred hosts of the transferring mites; but even bees over 30 days old are acceptable hosts if young bees are not available. The development of a mite population in the bee colony is cyclical with the heaviest infestations (mite per bee and mite per colony) being found in the winter or non-productive months.

DETECTION

Because of the microscopic size of the mite and its life cycle there are no reliable field indicators for the presence of the pest. The pest may go undetected for one to five years and then result in the death of the entire colony, which normally occurs in the late winter or early spring when mite numbers are highest and bee numbers are lowest. A severely infested colony may result in the presence of crawling bees on a warm winter or early spring day or walking bees with unhooked or "K" wings. However, this terminal indicator is soon followed by the death of the entire colony.

Laboratory procedures are available for the detection of the mite but these require the dissection and microscopic examination of the adult bees. Beekeepers who are concerned about tracheal mites or are suspicious that they may have tracheal mite infections should contact their local bee inspector, County Cooperative Extension Office, or the Extension Apiculturist at NCSU.

CONTROL

CHEMICAL CONTROL:
At the present time there are two products labeled for the control of tracheal mites in the U.S. They are menthol sold under the trade name of Mite-A-Thol® and formic acid which is sold under the trade name of Apicure®.

Both menthol and formic acid are naturally occurring products in honey but they should only be used in the labeled forms which are Mite-A-Thol and Apicure. Mite-A-Thol is a crystal form of menthol and Apicure is a formic acid preparation in a gel base. The misuse of either product can result in bee death and affect the flavor and saleability of the honey.

Of the two products, Apicure is the product of choice because it controls both tracheal mites and varroa mites, the more serious mite pest in N.C. (see Beekeeping Note 2.03, Varroa Mites). In addition, Apicure is less dependent upon ambient temperature for its effectiveness than is Mite-A-Thol. The best time to use Apicure for tracheal and varroa mite control is in the late summer or early fall. Both Apicure and Mite-A-Thol are most effective when honey bee brood is at a minimum and a treatment prior to winter conditions will be most effective in keeping mite levels from becoming a serious problem. Apicure becomes ineffective at temperatures below 45 degrees F.

Mite-A-Thol (menthol) is just as effective in controlling tracheal mites as is Apicure but it does not control varroa mites and it is ineffective at temperatures of less than 60 degrees F. The most effective time to use this product for tracheal mite control is prior to winter conditions when bee brood levels are at a low level so late summer or early fall treatments are best.

NON-CHEMICAL CONTROL:

In addition to the use of the two chemical controls, there are two other options that beekeepers should consider in tracheal mite control. These include the use of resistant stocks of bees and the use of vegetable shortening patties. Be advised that the beekeeper may still have to use chemical controls for the tracheal mites, but the use of these procedures may reduce the number of chemical treatments that are needed.

Resistant bee stocks, such as the Buckfast bees, have shown to be effective in reducing the impact of tracheal mites on honey bees. There are several strains of bees that show promise in this area, but the beekeeper should realize that the bees are really only tolerant and not really resistant to the mite pests. Any bee stock should be considered for characteristics other than just mite resistance in making a decision as to which bee to use.

The second non-chemical control of tracheal mites for beekeepers to consider is the use of vegetable shortening patties. The use of these vegetable shortening and sugar patties seems to interfere with the transfer (spread) of mated tracheal mites from their old bee host to a new bee host. The patties are most effective when used in the fall to early spring period. Patty preparations are available from most of the major bee suppliers.

The use of resistant (tolerant) bee stocks and the vegetable shortening patties have shown to be effective in reducing the impact of tracheal mites on honey bees, but chemical controls may be necessary even with the use of these products.

SPECIAL NOTES ON TRACHEAL MITES

1. This honey bee pest is not as serious a problem to N.C. beekeepers as it was in the 1980's and early 1990's; however, it can still be a problem and result in colony loss.
2. There are no obvious field symptoms that the beekeeper can use to diagnose the presence of this pest in the apiary. The presence of crawling adult bees or walking adult bees with unhooked "K" wings in the late winter or early spring is an indication of a severe tracheal mite infestation, but this is a terminal symptom and the bee colony will probably die within a few days.
3. Tracheal mites only affect the adult bees and have no affect on the brood. Good management practices that keep adult bee populations strong will help the bee colony to "outgrow" this pest problem.
4. There are effective chemical controls for the tracheal mites including Apicure (formic acid in a gel formulation) and Mite-A-Thol (menthol in a crystal form).
5. If you are in a region of the state that is undergoing problems with tracheal mites or think your bees may be infested, then contact one of the following for assistance: local NCDA bee inspector, county Cooperative Extension Office, or the extension Apiculturist at NCSU.
6. For updated information on registered pesticides for use against tracheal mites and other honey bee pests, visit the N. C. Agricultural Chemicals Manual online at: http://ipmwww.ncsu.edu/agchem/chpt.5/501.PDF
   To view this PDF file, you must have Acrobat Reader on your computer. Additional information can be found at the NCSU Apicultural website: http://entomology.ncsu.edu/apiculture

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ebjh/d2

The Small Hive Beetle: A Pest of Honey Bee Colonies

The small hive beetle, Aethina tumida, *was first detected in the United States in 1996 near Charleston, South Carolina. In the spring of 1998 in Fort Pierce, Florida, a scientist with the Florida Department of Agriculture and Consumer Services positively identified this beetle as the small hive beetle (SHB), a destructive pest of honey bee colonies. Prior to its detection in the United States, the only recorded sightings of this insect occurred in the southern regions of Africa.*

During the summer of 1998, the beetle was blamed for the loss of more than 20,000 honey bee colonies in Florida. The beetles spread quickly. That same year, beekeepers and inspectors also reported occurrences in Georgia, South Carolina, and North Carolina. Since 1998, the small hive beetle has become established in most counties in North Carolina as well as across most of the United States. This demonstrates its remarkable ability to disperse by flight and human transport.

DESCRIPTION

Adults

An adult small hive beetle is 5 to 7 millimeters long and brown to black in color (Figure 1A). The SHB is a member of the beetle family Nitidulidae and, therefore, has the club-shaped antennae that are common within this family. For instance, the picnic beetle, which is often mistaken for the SHB, has similar antennae. Other distinguishing characteristics include a shield-shaped thorax and broad, flattened legs. Adult beetles tend to hide on the bottom of the hive or just under the inner cover, and they scatter quickly once the hive is opened. This behavior can make them difficult to locate. Therefore, they may go unnoticed at low levels of infestation.

Larvae

SHB larvae are small, white, worm-like, and approximately 10 to 12 millimeters long (Figure 1B). The larvae appear similar to wax moth larvae, but SHB larvae are distinguished by their dorsal spines. A wax moth larva has legs on its thorax and prolegs on its abdomen, whereas an SHB larva has six legs on its thorax.

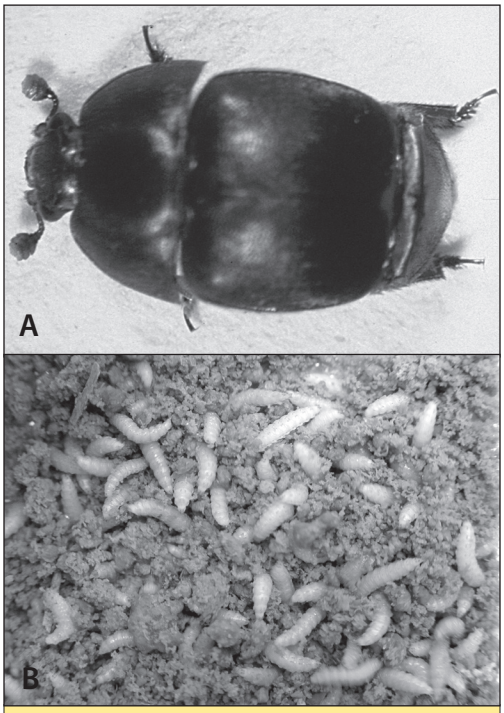

Figure 1. (A) Adult beetle. (B) Small hive beetle larvae in hive debris.

Photos courtesy N.C. State Apicultural Program

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LIFE CYCLE

As long as a colony of bees remains strong, adult SHBs are not generally destructive and may live in the hive as adults in large numbers for long periods of time without causing problems. If a colony becomes stressed or weakened, however, the beetles will take advantage of this opportunity and begin to lay eggs. Within 24 hours, these eggs hatch into very small larvae that begin to feed immediately. The larvae feed on the honey and pollen stores, as well as on the developing brood. In doing so, they tunnel through the comb and cause stored honey to run out, creating a sticky mess that, in extreme cases, causes the adult honey bees to abandon the hive.

Under ideal conditions, SHB larvae feed for 7 to 10 days. Then they leave the hive, crawl on the ground to a suitable location, dig into the soil, and pupate. Pupation takes three to five weeks (or longer during cooler temperatures), after which the new adults emerge from the soil and seek out a beehive to start the cycle all over again. The new adult beetles can survive a winter within the cluster of bees inside the hive.

IMPACT AND FUTURE OUTLOOK

When the SHB was first detected in North Carolina, the N.C. Department of Agriculture and Consumer Services (NCDA&CS) set up a quarantine with the goal of minimizing its spread and possibly eradicating it. The quarantine was lifted in July 2003 because the beetle had successfully established itself across the state and thus eradication was no longer an option. Although entomologists originally believed that SHBs could survive only in sandy soil and warm climates, the beetles have demonstrated that they can survive in just about any kind of soil. They can also survive extreme winter conditions.

The arrival of SHBs means that beekeepers must make some changes in the methods they use. When they first encountered the destructive potential of this honey bee pest, many beekeepers thought that the outlook for the whole industry was grim. But when beekeepers make a few adaptations to their beekeeping practices, the outlook for the industry does not appear as alarming.

PREVENTION

In the past, some of the more severe problems caused by SHB infestations occurred in the honey house where supers had been stacked and were waiting to be extracted. Beekeepers must take preventive measures to ensure healthy colonies and thus minimize hive infestations by SHBs. The following precautions should be taken to keep these beetles from infesting bee colonies:

- When colonies die for any reason, remove the equipment from the yard immediately and store it properly before beetles infest it.
- Extract honey from supers immediately after removing the supers from the colony.
- Keep the honey house clean.

These are some other recommendations that should be followed to help prevent invasions and infestations of the small hive beetle into your bee yard:

- Do not throw burr comb on the ground around the hives. It is better to collect all excess wax in a bucket and remove it from the yard.
- Minimize the amount of time inspecting colonies, as the beetles easily detect the bees' alarm pheromone. This makes the beetles scatter and hide.
- Remove excess supers from the colony, as frames with few or no adult bees make good hiding places for beetles.
- If larvae are found on the bottom board, do not brush them off onto the ground. Doing so will only lead to more adult beetles in a few weeks. Any larvae found should be removed from the colony and killed by either freezing them for 24 hours or placing them in a closed container with soapy water.

TREATMENT

Inside the hive

For controlling the SHB inside the beehive, coumophos is the only registered chemical pesticide available. This product (sold under the trade name of CheckMite+) is formulated as plastic strips impregnated with the pesticide. The strips are cut in half and attached to a small piece of cardboard placed on the bottom board of the hive. The beetles will hide beneath the cardboard and contact the pesticide, which kills them. In North Carolina, CheckMite+ is a restricted-use pesticide. Thus, you must have a pesticide applicator's license to purchase and use it. Coumophos is an organophosphate that can be very dangerous to humans and honey bees if misused. It is important to read the label and follow the directions carefully. These precautions are especially important:

- Honey supers must be removed prior to treatment.
- If honey is produced while a hive is being treated, the honey cannot be sold or used for human consumption.

A nonchemical means of inside-the-hive control is the West small hive beetle trap. This is a two-piece plastic trap that sits on the existing bottom board. The top piece has small holes, and the bottom is filled with vegetable oil. As the beetles enter and move throughout the hive, the bees tend to chase them, causing the beetles to look for a hiding spot. The beetles try to escape the harassment of the bees by exiting through the holes of the trap. Then they fall into the oil and drown.

Photo courtesy N.C. State Apicultural Program

Figure 2. Adult small hive beetles (circled) crawling on the surface of a comb inside a beehive.

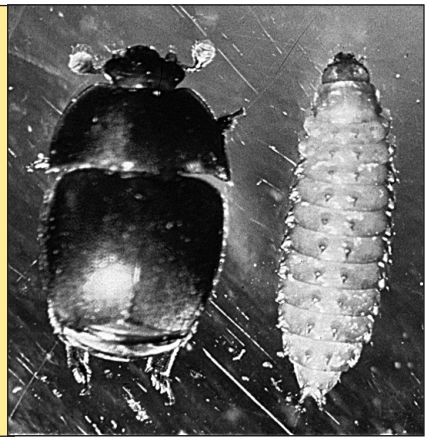
Outside the hive

Another product, GuardStar, is available for control outside the hive if larvae are observed crawling out of a hive entrance. GuardStar is a liquid treatment that is mixed with water and applied to the ground around the hive to kill the beetles pupating in the soil. The active ingredient is permethrin, a synthetic pesticide that is *highly toxic* to honey bees. Therefore, this product should be applied with great caution.

At this writing in early 2006, there are still many unknowns about this beetle, such as their mating cues and the signals they use to locate a hive. Researchers are working to decipher these cues to SHB behavior, which may lead to better control measures in the future, such as lures and bait traps.

If you think you have small hive beetles in your hives, you should contact your regional NCDA&CS apiary inspector before you begin treatment. Once the presence of the beetles has been verified, treatments may be used as needed. But neither CheckMite+ nor GuardStar should be used as a preventive measure.

Figure 3. A comparison of a small hive beetle adult (left) and larva (right).



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For more information, contact the following:

Honey Bee Inspection Program Office
N.C. Department of Agriculture
Telephone: 919-233-8214
Web site: www.agr.state.nc.us/plantind/plant/apiary/apiary.htm

Honey Bee Program Research Facility
N.C. State University
Telephone: 919-513-7702,
Web site: http://entomology.ncsu.edu/apiculture

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For access to additional Beekeeping Notes, visit the following Web site: http://www.cals.ncsu.edu/entomology/apiculture/Beekeeping_notes.html

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The beekeeper is more likely to see the adult moth but it is the larval or caterpillar (worm) stage that causes damage to wax comb. The larva is most destructive to beeswax combs in storage, especially in areas that are dark, warm and poorly ventilated. Annually it is estimated that the wax moth causes more than 5 million dollars in losses to beekeepers in the U.S.

The wax moth is regionally called the bee moth, the wax (or bee) miller or a webworm. There are both a greater wax moth, the most destructive comb pest, and a lesser wax moth, which, due to its smaller size, is less serious. There are three related moth pests of stored products that may also be found on combs or in bee hives. These are the Mediterranean flour moth, the Indian meal moth and the dried fruit moth. These last 3 feed mainly on pollen and are less destructive as they do not make extensive webs in the wax combs.

Most beekeepers know the damage wax moths cause. The moth life cycle consists of 4 stages. The first life stage, the egg, is tiny. Eggs are not noticeable unless we specifically look for them. Usually the female adult lays her eggs in batches. The eggs are laid in cracks between hive parts in dark out of the way places. Females produce up to 300 eggs each.

Wax moth eggs hatch to the larval stage in 5 to 8 days. New larvae burrow into beeswax comb attempting to reach the comb midrib. They are specialists to eat and grow and feed for 1 to 5 months, depending on the temperature. When fully grown, they are 3/4ths of an inch long and look like your typical caterpillar. They have a dark, hard head capsule, 3 pairs of small segmented legs and several body segments, some of which have caterpillar prolegs. They are white initially, turning dark grey as they age.

In contrast to its name, the wax moth does not digest beeswax. It lives on impurities in comb and for this reason prefers to infest beeswax comb that has been used for brood rearing. Foundation is seldom bothered and only by small larvae that often die before reaching the adult stage. In capped honey, young larvae tunnel just below the cappings. This causes harvested honey to leak from packages and makes comb honey less attractive and salable.

The third life stage, or cocoon, is a transformation life stage from caterpillar to adult. Fully grown larvae spin a silk cocoon that is dense and tough. It does this in comb or in debris at the bottom of the hive but more frequently it is firmly attached to the frame or hive body. The cocoon is cemented into a boat shaped cavity the larvae chews in the wood. This damage persists in equipment long after the wax moth emerges. Once the cocoon is spun, larvae change to the pupal stage.

Wax moth pupae may hatch rapidly or take 2 months to change to the adult stage depending upon temperature. Adults are 3/4ths of an inch with longer wing span (1 1/4 to 1 1/2 inches). Males are slightly smaller and can be distinguished by a scalloped front wing margin compared to a smooth one in females. The wings fold roof-like over the body; wing scales and body are a non-descript grayish-brown. Adults often run before they take flight when disturbed.

Wax moths fly mainly at night. During daylight they rest in dark spaces. They have acute sensory capability to find and exploit beeswax. They readily enter bee hives to lay eggs but the bees keep their numbers under control. It is in stored equipment or in weakened or die out colonies that their numbers explode. We then find all 4 life stages, tunnels of silk throughout the combs, especially near midribs, deposits of dark fecal matter, cocoons stuck to frames everywhere and a disintegrating comb structure. If left to continue or not quickly detected all the beekeeper is likely to see is the gritty debris of comb remains on the bottom board and boat shaped cocoon attachments with no or little comb left intact.

CONTROL OF WAX MOTH IN COLONIES

The bees themselves are the best control of wax moth in active bee colonies. It is not unusual to find an occasional wax moth adult or larva in a colony. They will be in out-of-the way places and in areas bees can't get to such as areas between top bars and inner covers. The bees may even have sealed the caterpillar off with a propolis fence. If you have many combs, especially darker combs that have had brood in them, or a weak colony, more wax moths and their damage may be evident.

Beekeepers frequently state that wax moths are responsible for killing their colony. They are not capable of doing this. What has happened is that the colony became weak, or more likely lost its queen, and the population dwindled to where there were too few adults to protect the combs. The adult female lays her eggs and the caterpillars hatch and grow. The caterpillar protected in its silken tunnel is hard for the bees to remove. Before the beekeeper discovers the weakened or queenless colony, the damage can accelerate. Under favorable conditions in the southern U.S. or tropical climates, wax moths can completely destroy brood combs in a month.

In addition to insuring active, populous colonies, keeping the hive clean and free of debris can help reduce wax moth damage. The bees need access to all parts of the hive. Don't neglect to remove the debris that accumulates on the bottom board or in cracks and crevices. Reasonable removal of burr comb and propolis will also help remove places where wax moths can become established.

CONTROL IN STORED COMBS

When we remove and store drawn comb, we increase the opportunity for a wax moth infestation. The warmer the temperatures, the more vigilant we must be. Simply trying to put frames in plastic bags won't be enough because eggs could already be present. Storing drawn comb outside in the open air won't suffice either unless you are in an area of freezing winter temperatures of the northern states. If you store comb, plan to protect it from wax moth.

FUMIGATION

Several materials have been used to fumigate beeswax combs before placement in storage. For beekeepers in more northerly states, one fumigation may suffice as normal winter temperatures will keep wax moths under check over winter. Currently paradichlorobenzene (PDB) is the fumigant of choice. It can be purchased from bee supply dealers or at hardware and drug stores everywhere. Be sure you purchase 100% PDB and not the other common moth fumigant naphathlene.

PDB is heavier than air so you don't need to put it at the bottom of a stack of supers/hive bodies. Since it does not kill the egg stage, you need to be sure you have a continuous fumigation in areas of high temperatures. PDB cannot be used to fumigate honey filled combs.

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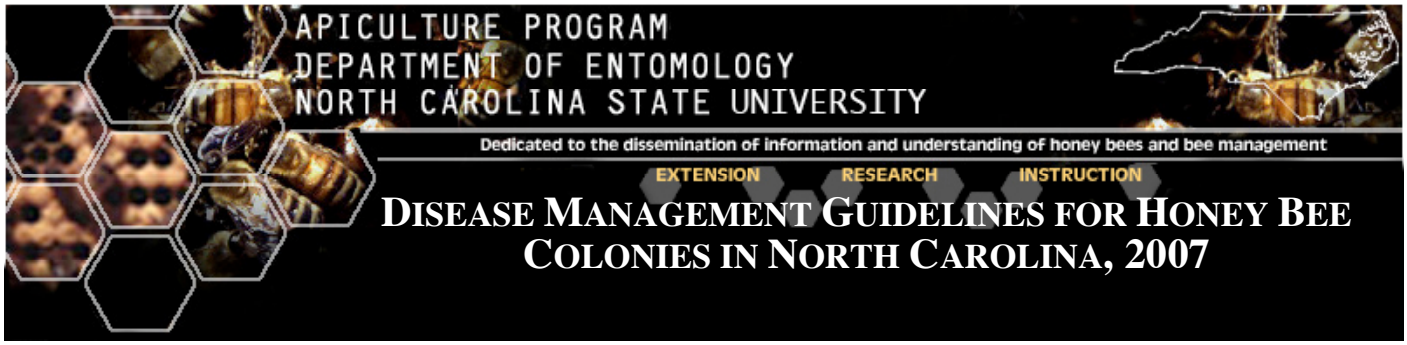
Participants in MAAREC also include state beekeeper associations, and State Departments of Agriculture from Delaware, Maryland, New Jersey, Pennsylvania and West Virginia.

MAAREC Publication 4.5. Original from American Bee Journal Vol. 132 (10):647-49. (1992) Author: Dewey M. Caron, University of Delaware.



DISEASE MANAGEMENT GUIDELINES FOR HONEY BEE COLONIES IN NORTH CAROLINA, 2007

It is the goal of every beekeeper to maintain healthy, productive colonies. This can only be accomplished by reducing the frequency and prevalence of disease within beehives. The following is an outline of recommendations for detecting and treating colonies for economically important parasites and pathogens of honey bees so that beekeepers may achieve this goal, and do so in a *sustainable* way for the long-term health of their colonies.

TABLE OF CONTENTS

VARROA MITES[1]

Cause

The parasitic mite, *Varroa destructor*

Symptoms

- Presence of adult mites on adult bees, brood, or hive debris
- Adults with shortened abdomens, misshapen wings, and deformed legs
- Dramatic decline in adult population and brood area, with spotty brood pattern

Means of prevention

- Screened bottom boards
- Mite-tolerant stocks, such as Russian, SMR, or Minnesota hygienic
- Drone-brood trapping
- Treatment of inert dusts

Methods of detection

- Sugar shake or ether roll
- Sticky board
- Alcohol wash
- Drone-brood inspection or visual inspection

The varroa mite

Treatment recommendations (see flow chart, page 9)

Spring (prior to honey flow)

- If varroa levels are equal to or more than **2-3 mites per 100 adult bees** (sugar shake, ether roll, or alcohol wash) or **40-80 mites per 24 hours** per sticky board, treatment is warranted.
- The use of volatile treatments, such as thymol or formic acid, are not recommended since they can result in decreased brood area. Use the appropriate dosage of **Apistan®** or **Checkmite+®** as long the mites have not previously developed a resistance.

Late spring/summer (during/immediately following honey flow)

- Never use any chemical treatments while honey supers are on hives.
- Employ one or more means of prevention, such as screened bottom boards or mite-tolerant stock.

Autumn (preparing for winter)

- Sample frequently for mites, preferably once a month.
- If varroa levels are equal to or more than **5-6 mites per 100 adult bees** (sugar shake, ether roll, or alcohol wash) or **100-150 mites per 24 hours** per sticky board, treatment is warranted.
- Rotate treatments as often as possible to minimize the prolonged exposure of any one chemical for the mites. This will help ensure that the mites do not develop a resistance to the available treatments.

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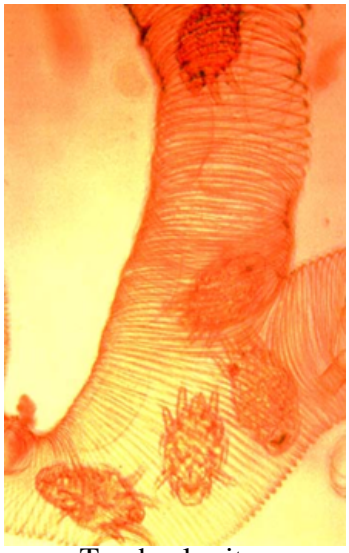
[1] For more information, see NCSU *Beekeeping Note* **2.03** on the biology, detection, prevention, and treatment of varroa mite infestations

TRACHEAL MITES[2]

Cause

The parasitic mite, *Acarapis woodi*.



Tracheal mites

Symptoms

- There is no one tell-tale sign of this disease.
- Disjointed wings or 'K-wing', distended abdomen.
- Bees often crawling on the bottom board appearing "morbid".

Means of prevention

- Resistant stock, such as Buckfast or Russian

Methods of detection

- Positive identification of tracheal mites can only be made upon microscopic observation of trachea (the breathing tubes of adult bees).
- If you suspect a tracheal-mite infestation, contact you regional NCDA&CS Apiary inspector.

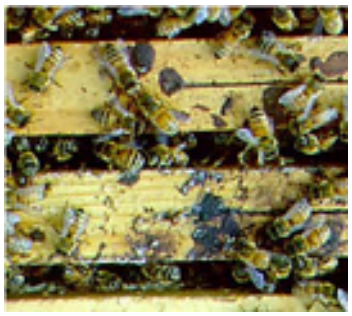
Treatment recommendation

- Verify infestation level whenever tracheal mites are suspected (see above).
- If the percentage of infested adult workers is 10% or greater, treatment is warranted. Treat colonies in the late summer or autumn.
- Recommended treatments:
  - **Mite-a-thol®** (menthol crystals)
  - **Mite-Away II®** (formic acid pads)
  - **Apilife VAR®** (thymol pads) or **Apigaurd®** (thymol gel)

NOSEMA

Cause

The protozoan, *Nosema apis*.



Bees defecating in the hive because of nosema

Symptoms

- There is no single symptom of the disease.
- Adults may have distended abdomens and defecate within the hive rather than take cleansing flights.

Means of prevention

- There is no exact means of prevention for nosema.

[2] For more information, see NCSU *Beekeeping Note* **2.02** on tracheal mites.

- Since the disease can be caused by stress, maintaining strong, healthy colonies is the best means of prevention.

Methods of detection

- Infections can only be confirmed by dissecting the digestive tract from individual bees. Diseased individuals have white, soft, and swollen ventriculae rather than brown and tubular.
- Hind gut contents can be examined under a microscope, and nosema spores can be counted using a hemocytometer.

Treatment recommendation

Spring (prior to honey flow)

- The only registered treatment for nosema is **Fumadil-B®**. Treat if there are more than **1 million spores per bee**.
- Mix **Fumadil-B®** with sugar syrup according to the label and feed to bees.

Late spring/summer (during/immediately following honey flow)

- No treatment warranted. Maintain strong colonies.

Autumn (preparing for winter)

- Treat if there are more than **1 million spores per bee**.
- Mix **Fumadil-B®** with sugar syrup according to the label and feed to bees.

AMERICAN FOULBROOD (AFB)

Cause

- The spore-forming bacterium, *Paenibacillus larvae larvae*.

Symptoms (see Table 1)

- Brood is dull white, becoming light brown to almost black.
- Age of dead brood is usually older sealed larvae or young pupae.
- Sealed brood is discolored and sunken, often with punctured cappings.
- Heavy infections have brittle, black scales that lie flat on the bottom of brood cells, formed from the dried remains of diseased brood. These scales contain billions of AFB spores and are highly contagious and persistent.

American foulbrood

Means of prevention

- Hygienic stocks
- Avoid robbing by keeping colonies strong
- Minimize comb swapping between hives
- Replace three combs in the brood chamber every year with foundation or drawn combs from honey supers

- Disinfect bee hives or suspect frames and brood boxes at the NCDA fumigation chamber using ethylene oxide
- It is **not** recommended to preventatively treat colonies with antibiotics, as it masks AFB symptoms (increasing the spread of the disease among hives) and resistant strains of AFB may develop.

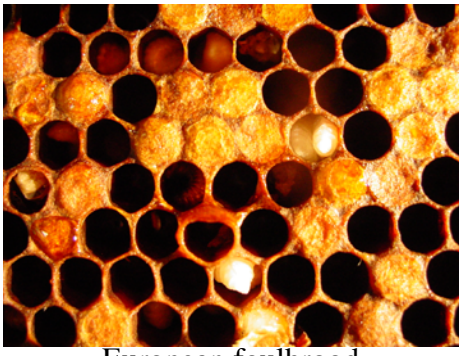
Methods of detection

- 'Ropy test'. Since larval remains of AFB-infected brood are elastic, a common field diagnostic is to pull the remains out of the cell with a toothpick or small twig. If the remains are elastic and "rope" out of the cell an inch or two, it is likely AFB rather than another brood disease.
- Holst milk test. This is a simple procedure that can be accomplished in most beekeeping operations. Place a suspect scale or smear of a diseased larva in a glass vial containing 4 ml of 1% powdered skim milk. Place the tube in a warm place (preferably at 37ºC). If AFB is present, the suspension should be clear in 10-20 minutes, since *P. larvae* spores produce proteolytic enzymes.
- Other, more sophisticated tests can be performed in the laboratory. Contact your regional NCDA&CS Apiary inspector for details.

Treatment recommendations

- Verify infestation and distinguish from other brood diseases (see Table 1).
- Contact your regional NCDA&CS Apiary inspector to inform them of an AFB outbreak.
- Burn all frames and euthanize bees
- Scorch or fumigate empty brood boxes, bottom boards, inner covers, and lids

EUROPEAN FOULBROOD (EFB)


European foulbrood

Cause

- The bacterium *Melissococcus pluton* and associated flora

Symptoms (see Table 1)

- Brood is dull white, becoming light brown to almost black.
- Age of dead brood is usually younger, unsealed larvae.
- Consistency of remains are rubbery and granular, not elastic.

Means of prevention

- EFB is largely a disease caused by stress. Thus maintaining a strong, healthy colony is the best prevention of the disease.

Methods of detection

- Visual inspection

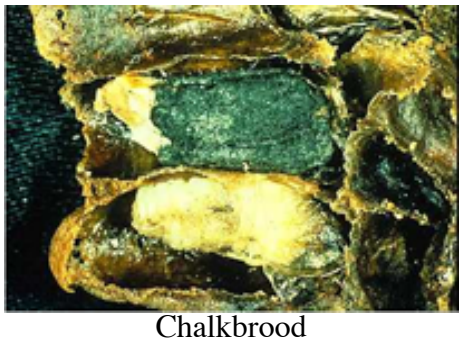
Treatment recommendations

- Verify infestation and distinguish from other brood diseases (see Table 1).
- For colonies with light infections, reduce the area of the brood nest, replace infected combs with foundation, and keep colony population strong.
- For colonies with heavy infections, treat with **Terramycin**®. Feed to colonies in powdered sugar by dusting the appropriate amount on the top bars on the outside of the brood nest.
- For all cases, maintain a hive quarantine (i.e., do not exchange frames from or into the hive) and be vigilant for re-emergent signs of EFB.

CHALKBROOD

Cause

- The fungus, *Ascophera apis*


Chalkbrood

Symptoms (see Table 1)

- Hardened, white or black "mummies" that resemble the consistency of chalk
- Mummies can be located in capped or uncapped brood cells, or they may litter the bottom board or on the ground directly outside the front entrance of a hive

Means of prevention

- Chalkbrood is largely a disease caused by stress. Thus maintaining a strong, healthy colony is the best prevention of the disease.
- Chilling may also increase chalkbrood, so ensure that there is an adequate adult population to keep the brood nest warm during cold weather.

Methods of detection

- Visual inspection is fairly obvious, thus the presence of mummies is usually sufficient to confirm infection.

Treatment recommendations

- There are no chemotherapies for chalkbrood. Requeening may be beneficial.

SACBROOD

Cause

- A viral pathogen of bee larvae


Sacbrood

Symptoms (see Table 1)

- Dead larvae appear watery and granular with a thick skin that forms a sac.

- The head of an infected larva is lifted toward the top of the cell, resembling the shape of a canoe.

Means of prevention

- Sacbrood is largely a disease caused by stress. Thus maintaining a strong, healthy colony is the best prevention of the disease.

Methods of detection

- Visual inspection

Treatment recommendations

- There are no chemotherapies for sacbrood. Requeening may be beneficial, and maintaining a strong colony often the best cure for the disease.

WAX MOTHS

Cause

- Larvae of the *Galeria mellonella* moth

Symptoms

- Large, 1.5 inch larvae tunneling through the wax combs of weak hives or stored bee equipment
- Silk cocoons, typically found on the side bars or top bars of frames in infested hives or equipment

Means of prevention

- Maintain strong colonies and inspect weak colonies often
- Cycle combs through the freezer for 1-2 days before storing
- Place **Paramoth® crystals** on stacks of stored combs according to the label

Methods of detection

- Visual inspection

Wax moths

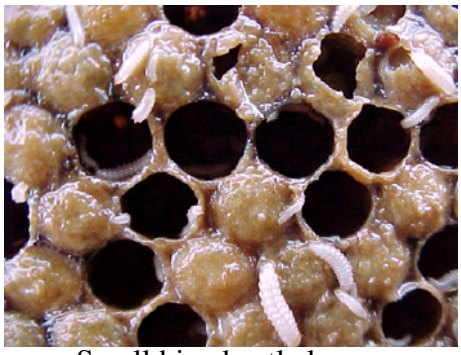
Treatment recommendations

- Store unused combs with PDB crystals. ***Never*** place crystals on a living colony, as the fumes are highly toxic to adult bees and brood.
- If heavy infestations are found, freeze combs for 1-2 days before reusing.

SMALL HIVE BEETLE (SHB)[3]

Cause

- Larvae of the beetle *Aethinda tumida*


Small hive beetle larvae

Symptoms

- Presence of adult beetles ***and*** eggs or larvae (presence of adults only does not necessarily indicate a problem).
- Watery, fermenting comb with small white grubs eating the wax.
- Larvae crawling out of the front entrance of the hive and burrowing into the soil.

Means of prevention

- There are no chemical products that deter SHB infestation[4].
- Beekeeping supply stores sell SHB traps that are inserted between the bottom board and brood chamber

Methods of detection

- Visual inspection and verification of SHB larvae.
- Young wax moth larvae can sometimes be mistaken for SHB larvae. The two can be distinguished since SHB larvae have dorsal spines, whereas wax moth larvae do not.

Treatment recommendations

- If adults are present, tape 1/2 a strip of **Checkmite+®** beneath a square of corrugated cardboard placed on the bottom board of the hive. The beetles often seek a refuge below the cardboard and come into contact with the pesticide. NOTE: the presence of **Checkmite+®** strips for the control of varroa mites does not simultaneously confer control for SHB.
- If larvae are present and crawling out of the hive:
  - Replace infected combs with foundation, then burn them or freeze them if salvageable.
  - Apply **GuardStar®** soil drench around the perimeter of the hive to kill developing pupae in the ground around the hive.
  - There are currently no in-hive chemical treatments for SHB larvae.

[3] For additional information about SHB biology, identification, prevention, and treatment, see NCSU *Beekeeping Note* **2.05**.

[4] Researchers are currently working on a SHB lure, but the technology is not yet available for use by beekeepers.

FLOW CHART FOR VARROA MITE DETECTION AND TREATMENT

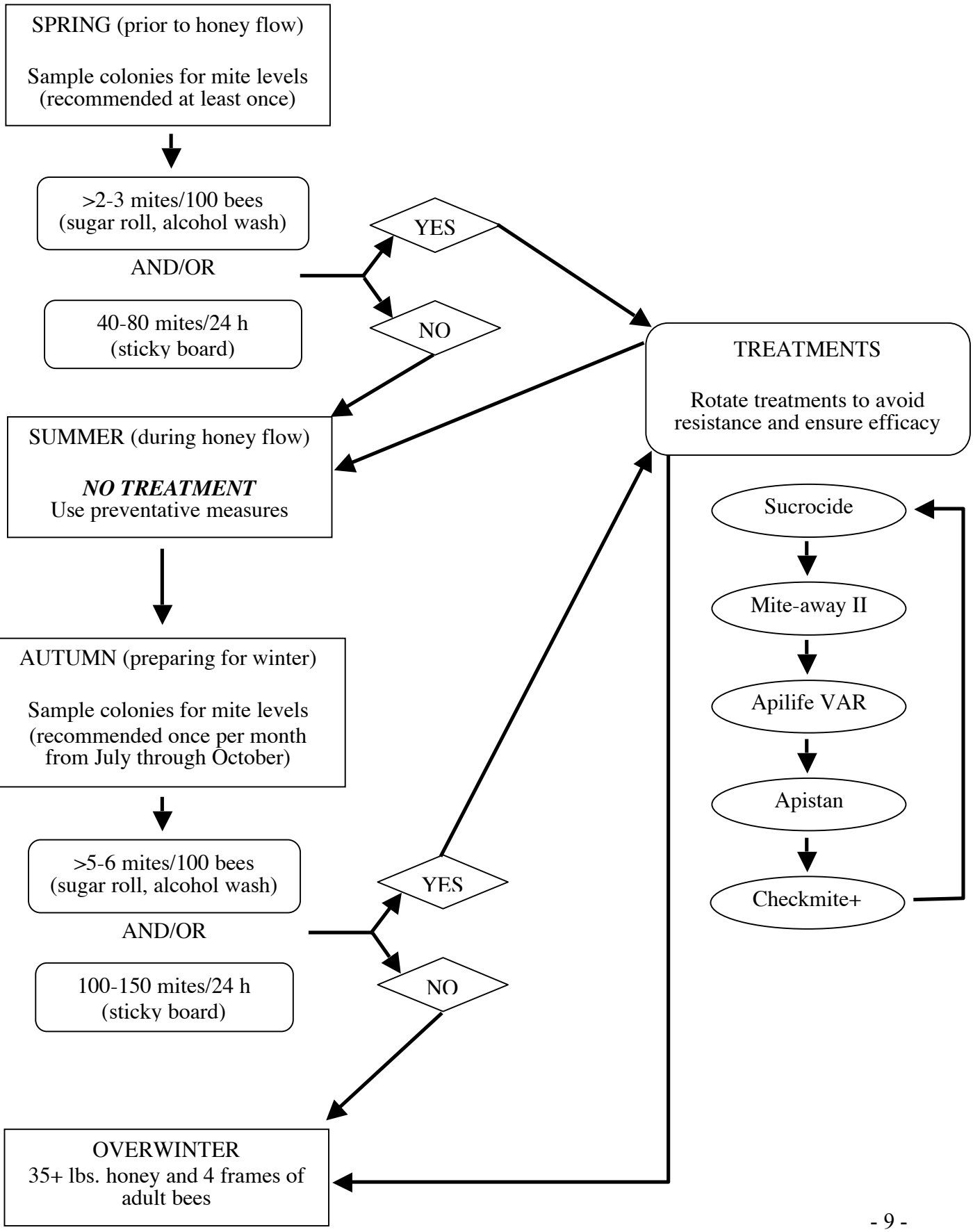


Table 1. Comparative symptoms of various brood pathogens of honey bees. Symptoms in ***bold italics*** indicate the most useful characteristics to distinguish the various diseases in the field. Table taken from Shimanuki and Knox (2000), Diagnosis of honey bee diseases, USDA Agriculture Handbook 690.

Symptom of dead brood	American foulbrood	European foulbrood	Chalkbrood	Sacbrood
Appearance of comb	Sealed brood is discolored and sunken, often with punctured cappings	Sealed brood is discolored and sunken, often with punctured cappings	Mummies found in sealed and unsealed brood	Scattered sealed brood with punctured cappings
Age	***Usually older sealed larvae or young pupae***	***Usually young, unsealed larvae***, but occasionally older coiled larvae	Older larvae in upright cells	Usually older sealed larvae upright in cells
Color	Dull white, becoming light brown, coffee brown, dark brown, then almost black	Dull white, becoming light brown, coffee brown, dark brown, then almost black	***Chalk white or black***	Grayish or straw-colored, becoming brown or darker
Consistency	***Soft, becoming sticky to ropy***	Watery and ***granular***; rarely sticky or ropy	Hard and rocklike	***Watery and granular; tough skin forms a sac***
Odor	Slight to pronounced odor of gym socks	Slightly sour to penetratingly sour	Slight, non-objectionable	None to slightly sour
Scale characteristics	Hard, brittle, and black. Uniformly lies flat on lower side of cell. Adheres tightly. ***Fine, threadlike tongue of dead pupae*** may be present.	Usually twisted in cell. Does not adhere to cell wall. ***Rubbery*** and black.	Does not adhere to cell wall. ***Brittle and chalky***, white to black in color.	Head prominently ***curled toward center of cell like a canoe***. Does not adhere to cell wall.
Picture				

Table 2. A list of products that are currently registered for the treatment of honey bee parasites, pathogens, and pests.

Brand name	Type(s) of chemical	Varroa mites	Tracheal mites	Nosema	AFB/EFB	Wax moths	SHB
Apigaurd	Thymol, an essential oils	**X**	**X**	-	-	-	-
*Apilife VAR	Blend of essential oils, particularly thymol	**X**	**X**	-	-	-	-
Apistan	Fluvalinate, a synthetic pyrethroid	**X**	-	-	-	-	-
*Checkmite+	Coumaphos, an organophosphate	**X**	-	-	-	-	**X**
Fumadil-B	Fumigilin, an antibiotic	-	-	**X**	-	-	-
GardStar	Pemethrin, a synthetic pyrethroid	-	-	-	-	-	**X**
Mite-a-thol	Menthol, an essential oil	-	**X**	-	-	-	-
Mite-Away II	Formic acid, an organic biopesticide	**X**	**X**	-	-	-	-
Paramoth	PDB crystals, a fumigant	-	-	-	-	**X**	-
Sucrocide	Sucrose octanoate, a synthetic biopesticide	**X**	-	-	-	-	-
Terramycin	Oxy-tetracycline, an antibiotic	-	-	-	**X**	-	-

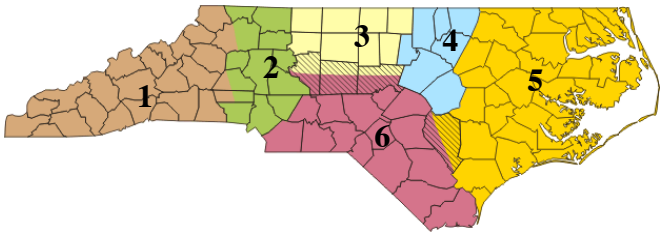
* - These products are registered as a Section 18 Emergency-use pesticide, and therefore require a private applicators pesticide license to purchase and apply.

AS ALWAYS, USE OF NON-APPROVED CHEMICAL TREATMENTS IS STRICTLY PROHIBITED, AS ARE ANY APPLICATIONS OF CHEMICALS THAT DO NOT FOLLOW THE REGISTERED LABEL.

CONTACT INFORMATION

North Carolina Department of Agriculture and Consumer Services, Apiary Inspection

POSITION	Name	Phone (M)
State Apiarist	Don Hopkins	(919) 218-3310
Region 1	Jack Hanel	(828) 230-4544
Region 2	Richard Lippard	(704) 880-3056
Region 3	Don Hopkins	(919) 218-3310
Region 4	Will Hicks	(919) 691-0022
Region 5	Adolphus Leonard	(252) 916-3444
Region 6	Bill Sheppard	(910) 690-9555



http://www.agr.state.nc.us/plantind/plant/apiary/apiarymp.htm

North Carolina State Beekeepers Association

Position	Name	Phone No.
President	Charles Heatherly	919-859-6995
1st Vice President	Greg Clemens	704-846-3784
2nd Vice President	Jennie Price	828-247-1640
Treasurer	Paul Madren	336-786-4848
Recording Secretary	Bob Gaddis	252-468-2029
Corresponding Secretary	Ruben Hill	252-523-3453
1st year director	Jeff Knight	704-764-3731
2nd year director	Michael Reynaud	910-323-4735
3rd year director	Janet Shisler	828-628-1758
Regional Rep-Region 1	Edd Buchanan	828-669-8936
Regional Rep.-Region 2	Jerry Isley	336-472-6325
Regional Rep.-Region 3	Judy Pick	919-942-4016
Regional Rep.-Region 4	John Brittle	252-637-6489
Regional Rep.-Region 5	Greg Clemens	704-846-3784
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http://www.ncbeekeepers.org

North Carolina State University Apiculture Program
http://entomology.ncsu.edu/apiculture

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Honey Bee Diseases, Pests and Medications

DISEASE	SIGNS	TREATMENT	CAUSE	METHOD
Diarrhea (Nosema)	Brown spots and streaks on hive box where bees come out.	**Fumadil-B** Providing good ventilation really helps!	**A protozoan** living in the bee's gut: *Nosema apis*	If it is a problem, treat package bees in spring with Fumadil in 1:1 sugar syrup. Treat hives with 2:1 sugar syrup in fall. Nosema can be a problem in winter.
American Foulbrood	An uneven pattern of brood with lots of empty cells. Some cell cappings may look darkened and sunken. Cells may be partially opened by bees. Larvae die after cell is capped. You might smell something bad.	**Terramycin** Destroy badly infected frames with scales of dead larvae by burning or discard in sealed trash bags.	**Bacteria:** *Paenobacillus larvae* (= *Bacillus larvae*)	Not necessary to treat if there is no problem. Watch for symptoms and treat if needed. Srinkle powdered sugar mixed with Terramycin according to the label instructions (3 treatments, 5 days apart).
Tracheal Mites	No obvious symptoms. Mites that are too small to see are inside the breathing tubes of the bees. In winter, infested bees may crawl out of the hive and die.	**Usually none required.** Some people use menthol crystals.	**A mite:** *Acarapis woodi*	No treatment needed. Most bees are resistant to tracheal mites. If your bees die in the winter, purchase queens from a different supplier.
Chalkbrood	Dead larvae become white or grey cottony "mummies" inside of cells. Mummies may be seen discarded by bees in front of hive. (cool weather problem)	**Usually none required.** Feed sugar syrup, add more brood or requeen.	**A fungus:** *Ascosphaera apis*	No drug needed. Chalkbrood often clears up when weather improves or after a new queen is introduced to the hive.
Varroa Mites	Look for Varroa mites in capped cells (especially drone cells) or on adult bees. In bad infestations, you see an uneven pattern of brood with some dead brood. Some bees may have deformed wings. Eventually results in death of the colony, especially early winter kills.	**Apistan strips** (fluvalinate) **Checkmite+ strips** (coumaphos) **Apilife VAR tablets** (contains thymol oil)	**A mite:** *Varroa destructor* (= *V. jacobsoni*)	Check for Varroa spring and summer with sticky boards. Many Varroa mites are now resistant to Apistan! Checkmite is very effective but is more toxic and could harm developing queens. Apilife VAR is less toxic but more labor intensive. <u>This is the one bee disease that must be controlled</u>!
Wax Moths	Webbing in comb. Wax moth larvae bore right through bee brood and comb, leaving lines of dead brood and webbing. Can destroy good comb! This is a problem of weak or dead hives and stored comb.	**PDB moth crystals (Paradichlorobenzene)** are used in stored equipment only. Not moth balls! Bees usually control moths in colonies. Remove dead colonies.	**Greater Wax Moth**: *Galleria mellonella* is especially attracted to combs containing brood and pollen.	Stack hive bodies or supers and put a piece of newspaper on top. Place 1/3 cup of PDB moth crystals on paper above every fourth box. Renew as crystals evaporate. Or kill moths by putting boxes in freezer.

Viral diseases are also important and increase with Varroa infestations but there is no known effective treatment. Follow all label instructions.

Orange
County
Beekeepers
Association

Bee School

United States Department Of Agriculture
Agricultural Research Service

How to Submit Samples

Submission of Samples for Diagnosis:

General Instructions

- Beekeepers, bee businesses, and regulatory officials may submit samples.
- Samples are accepted from U.S. states and territories, and from Canada; **samples are NOT accepted from other countries.** For samples originating from Canada click here.
- Include a short description of the problem along with your name, address, phone number or e-mail address.
- There is no charge for this service.
- For additional information, contact Bart Smith by phone at (301) 504-8821 or e-mail: bart.smith@ars.usda.gov

How to Send Adult Honey Bees

- Send at least 100 bees and if possible, select bees that are dying or that died recently. **Decayed bees are not satisfactory for examination**.
- Bees should be placed in and soaked with 70% ethyl, methyl, or isopropyl alcohol as soon as possible after collection and packed in leak-proof containers.
- USPS, UPS, and FedEx do no accept shipments containing alcohol. Just prior to mailing samples, pour off all excess alcohol to meet shipping requirements.

How to send brood samples

- A comb sample should be at least 2 x 2 inches and contain as much of the dead or discolored brood as possible. NO HONEY SHOULD BE PRESENT IN THE SAMPLE.
- The comb can be sent in a paper bag or loosely wrapped in a paper towel, newspaper, etc. and sent in a heavy cardboard box. AVOID wrappings such as plastic, aluminum foil, waxed paper, tin, glass, etc. because they promote decomposition and the growth of mold.
- If a comb cannot be sent, the probe used to examine a diseased larva in the cell may contain enough material for tests. The probe can be wrapped in paper and sent to the laboratory in an envelope.

Send samples to:

Bee Disease Diagnosis
Bee Research Laboratory
Bldg. 476 Room 204
Beltsville Agricultural Research Center - East
Beltsville, MD 20705

Last Modified: 12/14/2011

Diseases, Pests and Treatments Resource Listing

Books

The Hive and the Honey Bee - Dadant & Sons, available at www.dadant.com
The latest edition of the classic book on beekeeping. Completely rewritten, revised and enlarged. The best reference book on honey bees and beekeeping. 22 chapters, 33 world-famous authors, hundreds of photos and drawings, clothbound with attractive gold stamped cover and spine, and many special features: new 52-page U.S. and Canadian honey plants table, updated Africanized honey bee information, parasitic bee mites management, business practices, marketing, hive products, bee behavior, pesticides, and more.

Natural Beekeeping: Organic Approaches to Modern Apiculture - Ross Conrad, ISBN: 1933392088
Conrad brings together the best organic and natural approaches to keeping honeybees healthy and productive here in one book. Readers will learn about nontoxic methods of controlling mites, eliminating American foulbrood disease (without the use of antibiotics), breeding strategies, and many other tips and techniques for maintaining healthy hives. Conrad's reservoir of knowledge comes from years of experience and a far-flung community of fellow beekeepers who are all interested in ecologically sustainable apiculture. Specific concepts and detailed management techniques are covered in a matter-of-fact, easy to implement way.

Online Resources

NCSU Extension
http://www.cals.ncsu.edu/entomology/apiculture/

Disease and Pest Photos
http://cyberbee.net/gallery2/main.php/v/Disease-and-Pests/